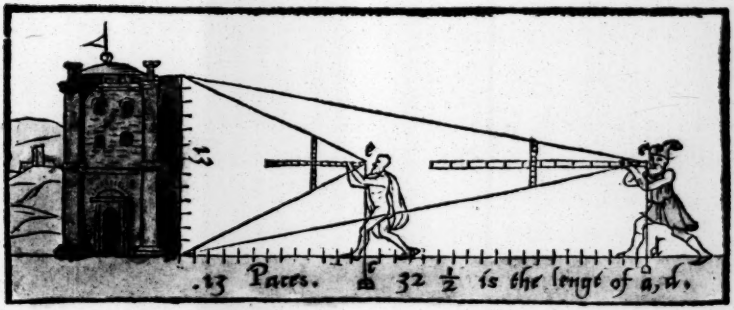
A BOKE NAMED
TECTONICON

briefelye ſhewynge the exacte meaſurynge, and ſpeady recke-
nynge all maner Lande, ſquared Tymber,
Stone, Steaples, Pyllers, Globes. &c. Further, declarynge the perfecte makynge and large vſe of the Carpenters Ruler, conteynynge a Quadrant Geometricall: comprehendyng alſo the rare vſe of the Squire. And in thende a little treatiſe adioyned, openinge the compoſition and appliancie of an Inſtrument called the profitable Staffe. With other thinges pleaſant & neceſſary, moſt conducible for Surueyers, Landmeters, Joyners, Carpēters, and Maſons.

Publiſhed by Leonarde Digges Gentleman,
in the yere of our Lorde.
1556.



¶Imprinted at London by Iohn Daye, for Thomas Gemini: dwellyng within the blacke Friers: who is there ready exactly to make all the Inſtrumentes apperteynyng to this booke.

ALthoughe (gentle Reader) manye excellent in Geometry, vpon infallible grounde haue put forthe diuerſe moſt certayne and ſufficient rules, touching the meaſuringe of all maner Superficiecis: yet in that the arte of numbringe hath bene required (yea, chiefly thoſe rules hidde, and as it were locked vp in ſtrainge tongues) they do profite, or haue furdered very little the moſte parte: certes nothinge at all, the Landmeater, Carpenter, or Maſon, wantinge the aforeſaied: for their ſakes I am here prouocked not to hide, but to open, and ſo encreaſe the talent whiche I haue receiued: yea, to publiſhe in this our tongue very ſhortlye (if GOD geue lyfe) a volume conteynynge the flowers of the Sciences Mathematicall, largely applied to our outwarde practiſe, mooſte profitably pleaſaunte to all maner men of this realme. In the meane time I ſhall deſire the Artificers aboue named to be contented with this little boke (a taſte of my good will towardes them) which I wiſhe euen ſo to farder the readers, as I knowe it ſufficient for the true meaſuringe and readye accompt of all maner Lande, Timber, Stone, Borde, Glaſſe, Pauement. &c.

Here mine aduiſe, ſhall be to thoſe Artificers that will profite in this, or any of my bookes nowe publiſhed, or that hereafter ſhall be, firſte confuſely to reade them thorow, then with more iudgement, and at the thirde readinge wittely to practiſe. So fewe thinges ſhall be vnknowen Note, oft diligent reading, ioyned with ingenious practiſe, cauſeth profitable laboure.

Thus moſt hartely farewell (louinge Reader) to whom I wiſhe my ſelfe preſente to further thy deſire and practiſe in theſe.

The pleaſaunt profite, or content of this little boke:
And in what it exceadeth all other publiſhed.

Ther Bookes tofore put forthe in our Engliſhe tongue conteyned onelye the bare meaſuringe of Lande, Timber, and Borde: howe agreable in all places to the rules of Geometrye, let the learned iudge. Here (gentle Reader) thou ſhalte plainelye perceiue throughe diligente readinge, howe to meaſure truely and verye ſpeadelye all maner Lande, Timber, Stone, Steaples, Pillers, Globes, Borde, Glaſſe, Pauemente. &c. without trouble, not payned with many rules, or obſcure termes. Nor yet with the multitude of tables, as here before hath bene: in whiche not a fewe errours were committed: for that cauſe no iuſte accompt might any waye be had. Further ye ſhal by this boke vnderſtande, the whole makinge and comely handelynge of the Carpenters Ruler, with the true meaſures. &c. And his vſe appointed to the ready meaſuringe of all kinde of Timber, Stone, Borde. &c. Alſo the leauelinge of groūdes, takinge of Heightes, is pleaſauntly and diuerſely practiſed by the Ruler. Ye haue here not the commune but the rare vſe of the Squire applied to Heightes Lengthes. &c. and to the findinge of the iuſte houre of the daye diuerſe waies: throughe the ayde of pleaſaunt tables, newelye adioyned to my generall Prognoſtication, by the whiche the proporcion of thinges direct or ſquirewiſe ſtandinge, are by their ſhadowes knowen.

To conclude, in the ende of this booke is added a treatiſe ſhewing the makinge and vſe of an Inſtrumente, by whiche ye ſhall gette Lengthes, Heightes, Breadthes, wideneſſes, where, or howeſoeuer they ſtande. Other neceſſarie thinges are conteyned in this little volume, whiche I committe to the diligent Readers.

The firste Chapter.

So there are few craftes-men, which haue all the kyndes of Arithmetike readely: soe I doo suppose none so ignorãt, but that thei do, or maye easely perceiue the simple significations of these Characteres or figures. 1.2.3.4.5.6.7.8.9.0. and also their strength, in the firste, seconde, and thirde roumes placed. *Characteres numerall.*

Besides that, thei must be familiar wt̃ these & such like Fractions

$\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{7}$ $\frac{1}{16}$ $\frac{1}{32}$ $\frac{2}{4}$ $\frac{4}{5}$ $\frac{9}{10}$ &c. The fyrst leftwarde betokeneth one second parte of an whole, be it Pearche, Inche, or a ny other measure: the nexte, one thyrde, then one seuenth parte: the other ensuyng, one sixtenth. So one thirty & two partes of an Inche. Then folow thre fourthes: four fiftes. The last is nine tenthes of an inch: that is nine partes of an inch, diuided into ten portions. *Fractions.*

These I do intend to put in my ensamples, and in my tables, and margines folowynge, to representé partes of Pearches or Inches. As, if I woulde write halfe an inche after this maner. $\frac{1}{2}$: Thre quarters of an Inche, thus $\frac{1}{4}$: One eyghth parte of a Pearche, on thys wyse, $\frac{1}{8}$. So of the rest.

¶ It is requisite also here to open what a Pearch, a Dayworke, a Roode, and an Acre is.

Althoughe there are diuers opinions engendred throughe longe custome in many places, of the length of a Pearch (vpon which our chiefe matter dependeth) yet there is but one true Pearche by Statute appoynted to measure by. Wherin is ordeyned. 3. barly cornes, drye, and rounde, to make an Inche: 12. ynches, a Foote: 3. foote, a Yarde: 5. yardes and $\frac{1}{2}$. a Pearche: 40. Pearches in lengthe, and. 4. in breadth, an Acre.

So an Acre by statute ought to conteine. 160. pearches: the halfe Acre. 80. pearches: a Roode, commonly called a quarter. 40. pearches: a Dayworke. 4. pearches. Loe here the Acre expressed wyth his Length and Breadthe.

Instrumẽts to measure with

I must not omit here to tel you what thing is meetest to measure land wyth. Thei vse commonly in the country, two poales, eyther of them the length of a pearch. They are very good: Yet for al kinde of lande, a corde. 5. pearches in length, well seared wyth waxe & rosyn, knotted or marked at the ende of euery pearche, is more mete & readier. But in my fantasy, the Instrument Geometrical, which is put forthe in thende of this boke, passeth all them & other, for the exacte truth, & quyckest spede. This instrument is so general & auaylable to so sundrye thynges, that it alone requireth a large boke, if it shoulde be sufficiently set forthe.

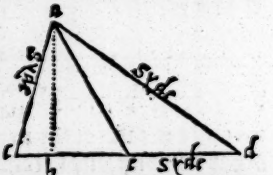
Poales

Corde knotted.

Profitable staffe.

Triangle.

Also I woulde not haue you ignorant what pece of lande is called a Triangle, whiche often shall hereafter be named. It is suche a fashioned piece as hath, or is imagined to haue thre sydes, and thre angles onelye: whether the sides be equal or otherwise: as this figure sheweth. Againe, note that a lyne is sayde to fall squirewise, when it cutteth any thinge, or any syde of a Triangle full crosse, lyke vnto a Squyre: As the hangynge prycked line, a.b. in. c.d. the base line of the Triangle. Loe, it cutteth the syde squyrewise, or full crosse, in the poynt b. and not as the other lyne a.e. dooeth. The Base of any tryangle is here called that syde, whiche is cut squyrewise of the hangyng lyne.



Line fallinge squirewise.

Base line:

Circle

Circumferẽce

Centre

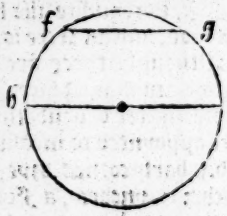
Diametre.

semidiametre

Arcke.

Paralleles

Concernynge a Circle, knowe that the compasse of any circle, is named his circumference: the myddle poynt in him his Centre: the ryght lyne h.i. that goeth ouerthwart that Centre, touchynge the circumference on bothe sides, is hys Diametre: the halfe of that line, the Semidiametre. Also an arcke is a pece of the circumference cut away, as pe se the arcke aboue the lyne f.g. Also f.g. and. h.i. in this circle are named Parallels: for that they differ equally in al places, the one from the other.



Nowe because practyse and experience sheweth me, that there is almoste no lande, but it maye easelye be broughte by imagination, to a Triangle or triangles, and so mooste truelye measured: therfore to be shorte, thys order shalbe taken. I wyl fyrst figure and set afore your eyes Triangled lande, and other whyche by ima-

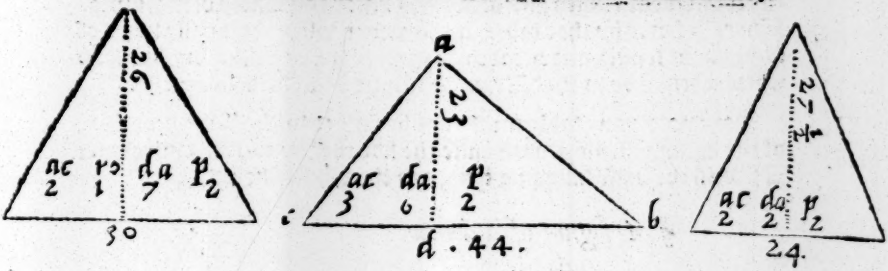
imagination shalbe brought into triangles. Then I shall teache the true measuryng of them: I meane how to synde a length & breadth, wyth whiche ye shall enter the Table of accompt folowynge, where the acres, and odde pearches, if there be any, shall appeare. As these sygures are measured, so all tryangled land, and other brought into triagles, of what fashion soeuer thei be, shalbe mesured. And bicause it is requisite for true measuryng of all triangles, to synde a streight hangynge lyne, I shall shewe firste howe that Lyne is to be sounde, imagined, or drawen.

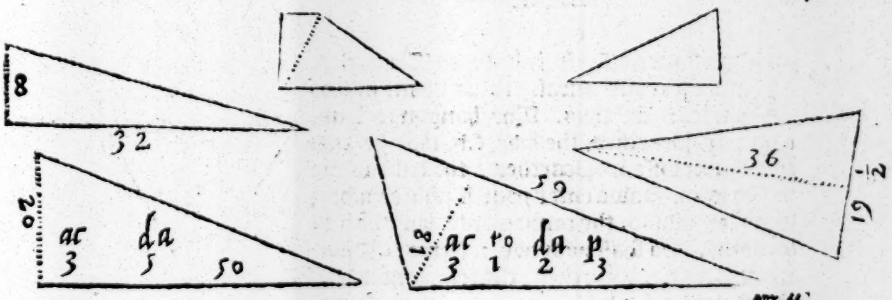
Howe the right hanging line in Triangles is drawen.

The.ii. Chapter.

To drawe a hanginge or plumbe line.

THis streyght hangyng lyne in all triangles, is euer drawen or imagined from anye Angle, cuttynge some one syde of that triangle squirewyse: as ye maye perceyue the pycked lynes in the Triangles folowyng. By the helpe of this lyne, all landes of triangle fashion, are brought to be mesured as ensueth.





B.ii.

The Arte of

Howe to meaſure all maner triangled lande.

The.iii. Chapter.

Euclide the firſt boke, 41. pro.

IF thou be an Arithmetrician multiplie this ſtreight hãgynge lyne, drawen as aboue is ſhewed, in halfe the number of pearches of that ſyde whyche it cutteth ſquirewiſe. For want of that knowlege, take the aforenamed pearches (I meane of the hangynge lyne, and halfe the ſyde which he cutteth) and wyth that Length and breadthe enter your table of accõpt, as there is ſet forth. So ſhall ye perceaue the number of Acres, Roodes, Dayworkes. &c.

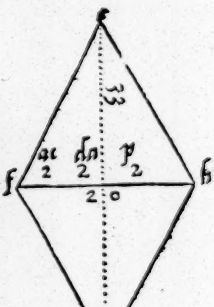
Enſample.

FOr the perfect meaſuring of triangles afore figured, & al other: I ſuppoſe the ſecond of theſe laſt. 9. fygures on thother ſide, hauing writtẽ about it. a. b. c. d. to be a pece of land, wherof I wold haue the true meſure. I finde bi a corde or otherwiſe, the pricked hanging lyne a. d. to be. 23. Pearches: the ſyde b. c. whyche it cutteth ſquirewiſe. 44. Pearches, whoſe halfe is. 22. Wyth theſe. 22. and. 23. the conuenient length and breadth, I enter the Table of accompte. There I fynde by that table, at the corner where bothe the lynes of conuenient length and breadth do mete, 3. Acres, 6. Dayworkes, and 2. Pearches to be in that Triangle. Thus of all before fygured.

This Table foloweth.

Here note, your table muſt euer be entred with all the pearches, of the hanging Line, & with halfe the ſide that he cutteth ſquirewiſe: Or with the halfe hangyng lyne, and the whole ſide cut.

¶ A figure of a double Triangle.

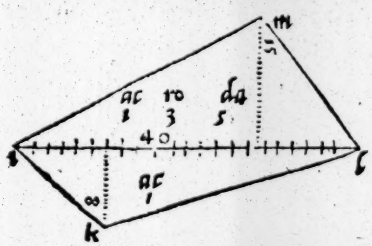


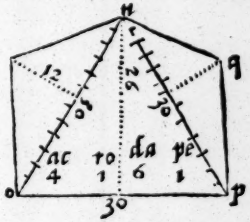
THis figure e. f. g. h. is but two Triangles: and therefore meaſured as aboue in two partes: Or thus. The hangynge lyne, e. g. is. 33. Pearches: the ſyde, f. h. that he cutteth ſquyrewiſe. 20. Pearches, the halfe of the which is. 10. Nowe enter your Table as afore, wyth. 33. and. 10. the conueniente lengthe and breadthe. So ſhall ye fynde. 2. Acres. 2. Dayeworkes and. 2. Pearches, the true contente of this fygure. e. f. g. h.

An

An other ensample.

Admit.i.k.l.m. lande to be measured. Because it is no maner Triangle, it must be brought by imagination, as I haue saied, into a Triangle or triangles. Which imagination is here signi-





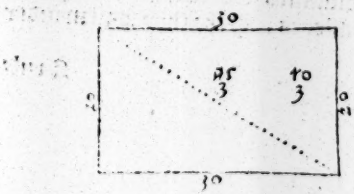
Figures of many Angles.

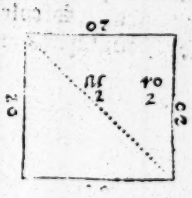
fied by the lyne dashed.i.l. When as aboue is declared, it ought to be measured (accordynge to the rule of Triangles) in two partes, because there are two triangles in that lande. So by prose ye shall finde in the vpper.i.m.l. one Acre.3.Rodes and.5.Dayworks: in the other.i.k.l.one Acre. Thus I gather the whole content of that land to be. 2. Acres. 3. Roodes, and 5. Dayworkes.

None otherwyse of the adioyned. n.o.p.q. and all other fygures folowyng, and other whatsoeuer they are, that by any meanes may be brought into triangles.

Furthermore knowe, that the fygure.i.k.l.m.is redely thus measured. Adde the pearches of bothe the hangynge lynes together: so haue ye.23. Wyth this number, and wyth halfe the pearches of the syde.i.l. whiche he cutteth squarewyse, beynge. 20. pearches, enter your table: so is founde as afore.

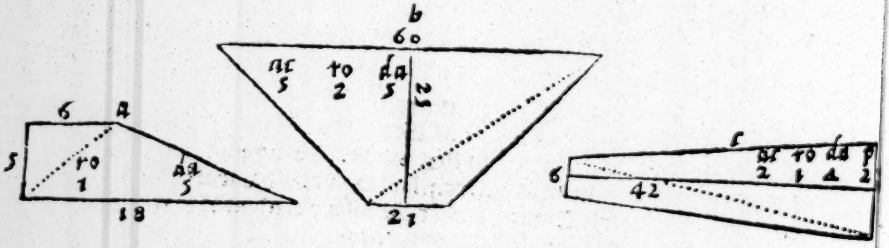
These two figures folowinge may also be thus measured, otherwise then by the rule of Triangles. Enter your table wyth theyr conuenient lengthe and breadthe. So shall ye fynde the contente of all suche.





These three fygures folowynge, although they maye be measured by the rule of Triangles: yet for quicker spede, they haue also their propre measurynge as ensueth.

Laye together the two sydes which are paralleles of the firste fygure a. that is. 6. and. 18. makynge. 24. the halfe is. 12. the breadthe. 5. Enter wyth. 5. and. 12. your table. So haue ye one rode, and fyue dayworkes. For the other two b, c, and suche lyke, ioyne the heades or endes in one: and enter your table wyth halfe of those pearches, and with the whole number of the middle line.



How by supputation to measure all Triangled Lande.

To mesure triangled lād bi supputatiō

Ioyne all the sides together: take halfe out of that halfe pulle euery side, noting the difference. Then multiply the differēces the one in the other: and the thirde difference augment in the product. That whiche encreaseth multiply in the halfe of al the sides ioyned. Then the Radix of the surmountynge summe is the content of that Triangle.

Foure rules folowing.

Now reste foure rules to be treated of. The firste for all maner regular square Superficies. The seconde for Rounde lande, and her partes. The third for Steples, Columnes, Globes, and their parts. The laste for Mountaynes and Valleyes. Here they shall in order followe.

A rule

A rule for all maner regular, or right ſquared land of manie ſides, as 5, 6, 7, 8, 9, 10, 20, 100. &c.

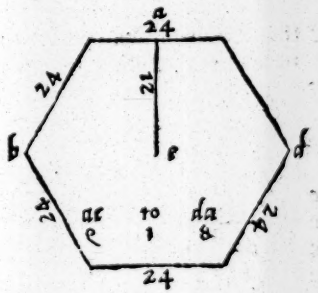
The.iiii. Chapter.

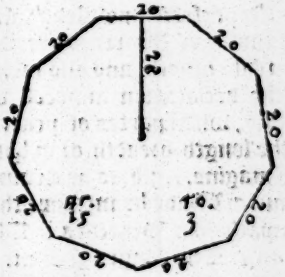
MEaſure and laye all the ſydes together, takyng the halfe number of Pearches there conteyned. Then drawe a right hangynge lyne from the centre or myddes of that fygure, to the middes of ſome one ſyde. And wyth that lengthe and the other enter your Table. Note that the Triangle of all ſydes like, and the Quadrate fygure, are alſo meaſured by this rule. *To meaſure lande of many ſides.*

Enſample.

SVppoſe this fygure. a. b. c. d. to be a fyreſquare pece of lande, and euery ſide. 24. pearches. The halfe ſumme of all ſides is. 72. pearches: the ryght hangynge pricked lyne, a. e. 21. Pearches. Wyth theſe two numbers ye muſt enter your table of accompt folowinge hereafter. And doue as is opened in the declaration there adioyned, when numbres ſurmount the Table, as they do here.

So ſhal ye finde. 9. Acres. 1. Roode, and. 9. Dayworkes, the content of this fygure. a. b. c. d. Euen thus is the other nyneſquared fygure meaſured, and al ſuch like.





The Arte of

A rule for rounde Lande, and the partes therof.

The.v. Chapter.

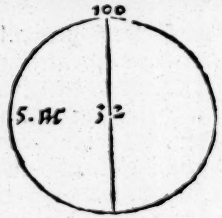
Archimedes in libello circuli mẽsurationis.

Halfe the Diametre multiplied in halfe the Circumference sheweth the content of any Circle.

Or thus more playnelye. Ye shall enter your Table wyth halfe the number of Pearches of the whole Circumference or compasse, and wyth the number of half the Diametre or Breadth. So haue ye the contente.

Ensample.

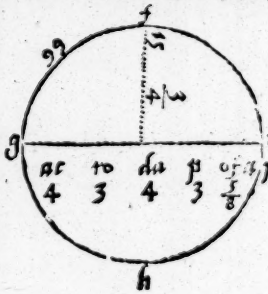
Suppose a piece of lande, wherof the compasse is. 100. pearches, the breadth. 32. Pearches. I woulde knowe howe muche lande is in this Figure. Enter your Table wyth halfe the compasse that is. 50. and wyth halfe the breadth that is. 16. pearches. Because in the table I can not finde. 50. (for the greatest Lengthe is. 40.) therfore I enter wyth. 40. and. 16. So is founde foure Acres. Then I enter agayne wyth. 10. pearches remaynyng, and. 16. the breadth as before: that bryngeth one Acre. Now to conclude, by addicion of. 1. & 4. I finde. 5. Acres in that rounde lande, whose halfe compasse is. 50. pearches, and the breadthe. 16. Pearches.



For perfette knowledge and vse of this Table folowinge, when partes of Pearches are adioyned, note well this other example that ensueth, and also what is sayd of the declaration annexed vnto the Table, when partes of pearches are in the length, breadth, or in bothe.

How parts of pearches are to be compted in measuringe.

Imagine. f.g.h. to be a rounde pece of lande: I finde by measure the whole compasse. 99. Pearches. The halfe is. 49. $\frac{1}{2}$. The hangynge Lyne or halfe breadth is. 15. $\frac{1}{4}$. Enter your table with the whole Pearches, that is. 49. and 15. leauynge out. $\frac{1}{2}$. and. $\frac{1}{4}$. whyche were but



but parts of pearches. So haue ye. 4. acres. 2. rodes. 3. dayworks, & 3. pearches. For those parts of pearches omitted at your first entring the table, worke thus. The halfe pearch, quarter, or other parts of a pearch in the length, must be reckened by them selues in the whole breadth: and those of the breadth contrariwise in the length. If there be suche odde partes in bothe, then recken them of the length in the whole breadth, and them of the breadth in the whole length: ioyning to the other aforegotten: remembrynge the product of the one fraction multiplied in thother, to be pulled from the encrease. To make this matter playne, I wyll take this laste ensample before. The one number wherwyth I shoulde haue entred my table, was. 49. $\frac{1}{2}$. the other. 15. $\frac{1}{4}$. I founde fyrst by entrynge with. 49. and. 15. (omittyng the odde parts) 4. acres. 2. roodes. 3. dayworkes, and. 3. pearches. Now for the encrese of the parts of pearches left out: I must (as I saide) reken thē of the length in the breadth, & cōtrariwise thē of the breadth in the length. Half. 15.. $\frac{1}{4}$. is. 7. pearches & $\frac{7}{8}$. Thre quarters of. 49. $\frac{1}{2}$. is. 37. Pearches. $\frac{1}{2}$. Which added, makes. 45. pearches: This adioyned to the number aforegotten, bryngeth the whole content of the rounde fygure, which is. 4. Acres. 3. Roodes. 4. Dayworkes. 3. Pearches, & $\frac{5}{8}$. of a pearch, the product of the one fraction multiplied in thother subducted. What must be done whē the nūbres wherw̄ ye shold enter, excede your table, coūsel ẏ declaration of your table there adioyned.

Of the halfe Circle.

For this half Circle, enter ẏ table w̄ halfe his cōpasse, & with half the Diametre of the circle, or w̄ the lēgth of the pricked hāging line, k. l. So the cōtent of this half circle, is. 2. acres. 1. rode. 7. dayworkes. 1. Pearch, & $\frac{11}{16}$. of a pearch.

To measure halfe circled lande.

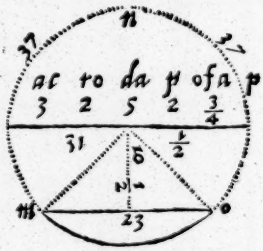
An other ensample of porcions and partes of a Circle.

Suppose. n. m. o. folowyng were a part of a circle, or pece of land, whose contente ye desired. The whole compasse of the Circle whiche this porcion representeth, is (as afore). 99. Pearches: his Diametre or breadth. 31. $\frac{1}{2}$. The pricked arcke or compasse n. m. o, is. 74. Now wyth the half breadthe or semidiametre of the circle. 15. $\frac{1}{2}$. & with. 37. the halfe of the pricked compasse: enter your table. So haue ye. 3. Acres, 2. Roodes, 5. Dayworkes, 2. Pearches, and. $\frac{1}{2}$. of a

pearche, the contente of the piece of Lande full of Pyckes, to the sydes of the Triangle pycked.

To measure partes of circled lande.

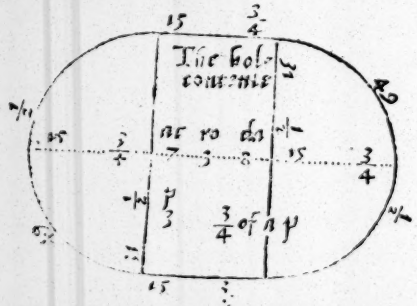
If ye desire to knowe the summe of pearches in thother porcion beneth the triangle, seperated by the lyne, m. o: ye must adde the cõtent of ỹ triãgle (which is. 3. Roodes, and. $\frac{1}{4}$. of a pearche, founde by the rule of Triangles) to the Acres & pearches before searched. So haue ye 4. Acres. 1. rode, 5. Dayworkes, 3. pearches, and. $\frac{1}{2}$. of a pearch. This subtracted or pulled from the number cõteyned in the whole Circle, the remayne is the pearches included in the small piece beneath the Triangle. That is. 1. Roode, 36. pearches, and. $\frac{1}{2}$. of a pearche.

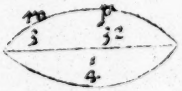


How mixed fygures are measured.

Lande compounde of circles or his partes.

I Thinke none nowe wyll doubt how these two fygures folowynge are measured, because they are made of porcions or parts of circles, whose measure is before sufficientlye opened: the one consistynge of two halfe Circles and a Quadrangle: the other beynge the porcion of the circle, m. o. doubled.





If anye euyll fashioned lande chaunce to be measured, whyche requireth to be brought in many Triangles, to saue labour, ye may adde some porcion vnto that, and make it square or otherwyse. So let it then be measured: and after from the product pul away that ye added: the remayne is the content.

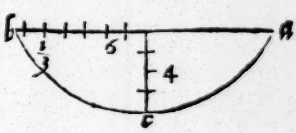
To

To synde the content superficiall, of Steples, Columnes, Globes, and their partes.

TO the Arithmetician I say. For picked Steples, multiply the whole side in halfe the Circumference of the base, addynge the playne of that base. For Pillers augmente the Circumference of the base in the height, puttyng to the playne of both Bases. For Globes, the Diametre in the Circumference multiplied: euen so of Fragmentes or Partes. Let them that be voyde of Arithmetike, enter my Table of accompte folowynge, wyth suche numbers as I now wylled the Arithmetician to multiply, not forgettyng what I haue before written: So I serue their turne. *To measure Steples, Columnes, Globes. &c.*

Or thus, by the rule of proportion, the partes of a Globe are founde.

Suppose. a.b.c. to be a piece of a Globe, and. 4. to be a Portion of the diametre, the whole being. 14. Thus I saye. 14. the whole Diametre geueth. 616. the contente superficiall of this Circle: what shal. 4. bynge? So haue ye. 176. whiche is the content of that pece.



To measure parts of globs

To synde the Diametre by some knowen portion therof.

IF ye be ignorant what lengthe the Diametre of that Globe is whose portion ye haue: the height or part of the Dimetient being. 4. foote, augment halfe the lyne a.b, whych is. 6. ½. in hym selfe, and the produce diuide by. 4. So haue ye. 10. to be added to. 4. whyche maketh. 14. the whole Diametre. *To synde the vnknowē Diametre of a Globe.*

The true measurynge of Mountaynes and Valleyes.

The. vi. Chapter

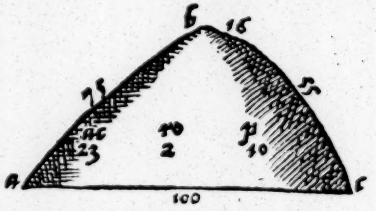
FIrst ye shal mesure the circuite of the fote, or base of the Mountain: then the cōpasse of the summitie or toppe: addyng thē together. So shal ye do of the Ascenses, that is, the going vp frō the fote to the top: ioynyng the measure of the longer & shorter in one. Now take the halfe of the circuites added, and the halfe part of the Ascenses ioyned, and enter your Table. There shall ye se the content. *To measure Mountaynes,*

Mountaynes and Valleyes.

Enſample.

Figure of a Mountaine.

A B. C, is the Mountayne: a. c. the circuite of the baſe, beynge 100. Pearches: b. the toppe. 16. Pearches. Whyche ioyned together make. 116. B. c. the one aſcenſe, is. 55. Pearches: the other. 75. Theſe added make. 130. The halfe of the circuites, is. 58. the halfe of the Aſcenſes. 65. Wyth theſe two Summes ye ſhall enter your table of accompt: where ye ſhall finde. 23. acres 2. rodes, and. 10. pearches, the true content of this figured hill.



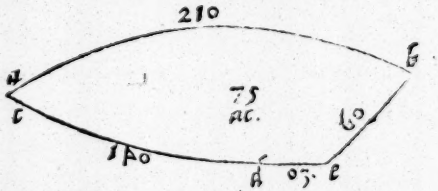
Of the Valley.

To meaſure Valleies.

AS in the Mountayne ye meaſured the circuite or compaſſe of the baſe or foote: ſo here contrary, ye ſhall meete rounde about the circuite, or compaſſe of the heigth of the Valley. And as ye gott the meaſure, or compaſſe of the toppe of the Mountayne: ſo meaſure the circuite of the deapth of the Valley. In like maner as ye meaſured the aſcenſe, that is, the goynge vp from the foote to the toppe: ſo meaſure the deſcenſe, or goynge downe of the Hyll to the depth of the Valley. The reſt all worke, as I haue ſhewed in meaſurynge the mountayne.

Figure of a Valley.

For more playnneſſe, beholde this enſample, or figure. If ye lay together the circuits of the height and depth, whiche is. 210. and. 30. takynge the halfe parte of theſe two circuites, makyng an. 120. than the two aſcenſes. 140. & 60, added in one produce. 200. the halfe ther- of beynge. 100. wyth this, and. 120. the other halfe of the circuite, ye may enter your table. That doynge, loe. 75. Acres.



Howe

IT cometh cõmunely to paſſe that Carpenters, Maſons, & ſuch lyke artificers are put ether to meſure timber euery way ſquare, or ſquared logs, broader on thone, thē on thother ſide, yea many times mutilate or vnperfecte ſtuffe: ſometymes 3, 5, 10, or 20, ſquare in the Heade, and ſo through, oftentimes rounde ſtone or tymber, wyth hollowed. &c. Afore I ſhewe vnto them what muſte be done wyth ſuche peces of Tymber or ſtone to gette their true meaſure, my deſyre ſhall be, that ſuche Craftesmen will leaue to be heady or ſelfwylled, yea ſo gredily to ſtycke to their olde corrupted rules, that vtterly they refuſe to be taught. Both learning and erperience declareth vnto me, that the grounds whiche the beſt of them haue are falſe. To open how and where, it nedeth not: neither doeth it appartene to inſtruction. Onely it may ſuffice hym that liketh the true way, here to receiue it appoynted to hym. Yet to ſatiſfie and content him which will not beleue any ſuch errours or falſe groundes to be: I ſaye (and truely) that the Ruler of tymber meaſure, which the more part of them hath, is not made by ryght arte. Beſides that their crafte in ſekynge the ſquare of ſome tymber, is very falſe. They vſe in meaſuring to lay the broader and narrower ſydes together in a ſumme: and to take the halfe of that number for the ſquare. Then they ſeke this vntrue ſquare vpon the falſe ruler: and ſo meaſuryng the tymber, they conclude of it vntruly. As this is corrupted, ſo are other groundes which they take to be infallible. Nowe to the purpoſe, touchyng the correction of thoſe errours with other not mencioned, wherby true meaſuryng may enſue: this way ſhall be taken. After I haue opened how ye muſt handle all ſuch faſhioned timber (as afore is ſpoken of) there ſhall folow a table, in whiche ye may fynde (as I wyll declare) the ſquare of any ſtone, or tymber. That knowen, it is requiſite to haue an other table immediatly folowyng, whiche may appoynt to all true ſquares, from .1. to .6. ynches, the iuſt lengthe to make a Foote euerye waye ſquare. Wyth that length agreable to your ſquare, your logge muſt be meaſured. And as oft as ye fynde it from the one ende to thother of your tymber, ſo oft ye may conclude the fote ſquare to be conteyned

In a foote ſquare is conteined 1728 *inches.*

ned in that tymber logge, or stone: that is, so many square fete there to be included. This table of tymber measure standeth in the place of a good Ruler, well decked with true measures. By this ye maye make or correct rulers at pleasure, as after appeareth.

Now orderly followeth the true measuring of all fashioned Tymber or Stone afore named.

How tymber or stone, foure square euery waye, or broader on the one then on the other side, is measured.

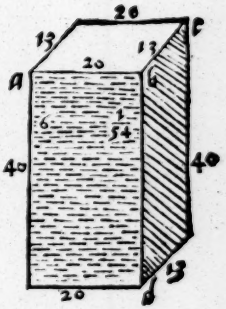
The. vii. Chapter.

If a pece of Tymber, or Stone be either equally square, or broader on the one syde than on the other, ye shall take the iuste measure, I meane how many inches the broder side coteineth: euē so of the narower. This done, ye must seke in the table of squares folowing, the measure of ỹ broader syde of the Tymber or Stone, in the vpper margyne of that table. Then loke for the number of inches of the equal or narrower syde, in the right part and hanging margyne. At the cōmune metyng, where the one nūber answereth directly to the other, there your true square shall appere. This square so found shal be referred to your table of tymber measure: in the whiche ye maye playnelye see (if you runne downe by the left margyne, vntyll your ynches square appeare) howe many fete or ynches of your ruler belongeth to a foote square. As often as that measure there founde is conteyned in the tymber or stone, so often and as many fete square ye may conclude (without doubt) that pece of tymber or stone to haue.

Ensample.

Suppose thys squared Tymber or Stone, a.b.c.d. were to be measured, the broader syde, a.b. 20. ynches: the narower syde. b.c. 13. ynches: the lengthe. 40. ynches. Now I muste seke the broader syde. 20. in the vpper margyne of the

of the table. The narrower ſyde. 13. muſt be founde in the ryght ſyde and hangynge margyne. At their cõmen metyng. 16. inches, and ½. part of an inche ſhall appeare. This true ſquare muſte be ſearched for in the Table of tymber meaſure. Therfore loke for. 16. in the margyne of that table. In the ſquares with him rightward, ye ſhall finde. 6. ynches, and ¼. whych is thre quarters of an inche. Somedele leſſe of your Ruler then. 6. and. ¼. layed out vpon the timber, maketh a foote ſquare. And that meaſure ſo diſcretelye handeled, is conteyned in the lengthe of your tymber fire tymes. Wherfore affirme fire fete there to be, beſyde that is left. ½. parte of a foote. Note becauſe the ſquares, at all tymes (as in this enſamples) ryſe not to euen inches, but ſometyme to odde partes: Therfore accordyng to your diſcretion, adde or take away ſome part more or leſſe in ſetting forth the fote ſquare, as aboue is parformed.



It were intollerable tediouſnes, yea impoſſible, to ſette foorth the true quantities of timber meaſure, to all odde quantities of ſquares The diſcrete handelynge of theſe, the wittye ſhall bryng to a ſufficient exactneſſe.

Of Tymber or Stone, 3, 5, 10, 20, or moe ſides ſquare. &c,

The. viii. Chapter

When Tymber hath diuerſe equall ſquares in the heade and ſo through: fyrſt meaſure all the ſquare ſydes round about the heade or ende of the tymber. Then take halfe the number of that whole meaſure for thone Breadth. Then meaſure from the Centre (which is the middle of the heade, or end of the tymber) to the myddes of one ſquare ſyde, betwene the two angles: and take the meaſure of that diſtance for the other Breadth. Nowe reſorte wyth the meaſures of theſe two breadthes (as tofore) to the Table of ſquares: ſeking the bigger number or breadth in the vpper margyne, and the other leſſe in the ſyde mar-

margine. With the square there founde, haue recourse to the table of tymber measure: and do as I haue instructed.

Ensample.

ADmit this smal pece of tymber, s. square e. f. g. h. shoulde be measured, euery syde ynge. 12. ynches. If ye adde togither in one summe all the. 5. sides, they make. 60 inches. The half is. 30. that serueth for one Breadth. Then the line. e. f. which goeth from the Centre or middes of the square to the middle of one syde, is. 8. ynches. The two numbers. 30. and. 8. must be sought (as afore) in the Table of squares folowyng. At the commune metyng, your square shall appeare. 15. inches and. ½. This square. 15. seke in the table of tymber measure. There ye may se ryght with it. 7. ynches, and. ²⁄₇. Nowe bicause of. ½. the odde quantitie of the square aboue. 15. ynches, laye somethyng lesse. Then se how often tymes that measure (so with discretion handled) is from the one ende of your timber to the other: and affirme so many times a fote square there to be, as that measure is founde in the length of your logge.

How rounde and hollowed Tymber, Steples, Pillers, Globes. &c. are to be measured.

The. ix. Chapter.

FIrst gyde the logge rounde about with some lyne: then diuide the lyne, whiche compalled that tymber, in two equal parts, kepe the one part for the bygger Breadth: After ye shal diuide agayn that whole length (the twenty and two part cast away) in three partes, & take the half of one of them for the other narower Breadth. With the measures of these two Breadthes, halte to your table, performing all thing as afore is opened.

En-

Enſample.

Suppoſe thys little piece of Tymber. i. k. l. m. were to be meaſured, the compaſſe or gyrdynge. 36. ynches, the halfe of that is. 18. being the one Breadth: then the thyrde part of. 36. is. 12. the halfe of it is. 6. whych is the other narower Breadth. Wyth theſe two numbers. 6. and. 18 enter the Table of ſquares folowyng, and ſo the table of tymber meaſure. At the laſt (all thinges performed as before) ye ſhal fynde in thys round logge, (the lengthe. l. m. beyng. 18. ynches). 1. foote and. ½. parte of a foote. Thys is ſufficient for all ſuche lyke.

A note of hollowed Tymber.

If it chaunce that hollowed Tymber be to be meaſured: meaſure the whole logge as though it were not hollowe, as aboue is declared. Then meaſure the narrower and broader ſyde of the hollowe: and ſee what is conteyned in that, as thoughe it were maſſy tymber. Nowe pulle out the content of it, from the whole aboue meaſured: the remayne of force muſte shewe what tymber is included in that hollowed bodye.

I Am vnable in fewe woordes to expreſſe to the vnlearned, by what meane Pyramidal, or picked regular Steples of all fashions are meaſured. Alſo howe Pyllers: howe the content of Globes or Bowles are ſearched: vnleſſe the art of numbryng were taſted. That beinge knowen: thus (as nowe foloweth) I teache.

Howe the Craſſitude of picked Steples is knowen.

Multiply the playne of the Baſe in the third part of the height: ſo ye haue the craſſitude. Or multiplye the content ſuperficiall (founde as I haue inſtructed) in the height of the ſteple,

takynge for your purpose the thyrde parte of that product.

Howe the content of Pillers is knowen.

Increase the Base playne in hys altitude or height: so haue ye your desyre.

Howe the Cubicall bodies of Globes are searched.

The content superficiall founde (as I haue opened) muste be multiplied in the first part of the Diametre: the product is that ye requyre. Or the thyrde parte of the Superficiall content in halfe the Diametre. Or multiplye the playne of the Circle in the whole Diametre: then take two thirde partes, whyche added make the crassitude.

Of the halfe Circle.

His superficial content multiplied (as is sayd) bringeth the magnitude of hym. If any manne requyre ensamples of these lasse matters, or more sufficient handlyng: let them resort vnto my bokes published of Geometrye: there they shall be satisfied. These little apperteyn to Carpenters or Masons, therfore not by ensample declared.

A generall Note.

When thou shalt be put to measure some body wythout order or fashion, lackyng parte of hys square, or hauyng more than his forme: if it lacke thou shalte make it perfect by obseruynge diligentlye the runnyng together of the sydes. The partes wantynge shall be measured as though they were there, whyche porcions muste be taken from the whole bodye measured.

Also when there resulteth anye more than the forme or regular square: firste measure the square bodye: then the crassitude whyche aboundeth. All put together do shewe the whole irregular bodye. This suffiseth.

A no-

How Tables, Bourdes, Glasse, or any suche like are measured, accordyng to their Length and Breadth onely to the foote square.

The. xi. Chapter.

This thyng is performed by the helpe of a large table folowyng, diuided in fiue smal tables, and as many margines. The firste left margyne beginneth at. $\frac{1}{4}$. whiche is one quarter of an ynche, and extedeth to. 6. inches, as ye may plainly perceiue if ye runne doune by that margine. This hath his table on the ryght side adioyned vnto him. The other taketh his beginnyng at. 6. inches. $\frac{1}{4}$. and endeth at. 12. hauynge hys proper table also. The thirde, from. 12. $\frac{1}{4}$. to. 18. And so from. 18. $\frac{1}{4}$. to. 24. Frō. 24. $\frac{1}{4}$. to. 30. The laste margin is frō. 30. $\frac{1}{4}$. to. 36. & there endeth.

Of this that is said, you may gather that euery margine hath his table on his right side. Also you must know that in the top & beneth I haue put (as in the table of timber measure) these wordes, fote, inche and partes, to signify fete, ynches, & partes of an ynche. Whensoeuer ye list to mesure Borde, Glasse, or any other such, with the Breadth of it enter this table: and seke that breadth in his proper margyne. There ye shal finde in right order how many fete, ynches, or partes of an ynch belonge to a fote square. So often as ỹ measure is in your stuffe, iust as many fete haue ye in that borde or such like. If the Breadthe excede thys Table: than diuyde that breadthe in partes and woorke as is and shall be declared. Now the ingenious applyeth this table for all maner breadthes most exactlye.

Ensample.

Suppose I haue a pane of glasse, or a borde, whose Breadth were 22. inches $\frac{1}{4}$. the Length. 16. fote. In the fourth margin I find this breadth. 22. and $\frac{1}{4}$. And euen with it in the table rightward I se. 6. ynches $\frac{1}{4}$. So muche of my ruler (wantyng some small quantity) maketh a fote. Now, bicause in the Lēgth of my borde (which is. 16. fote) that measure is founde. 29. tymes, and $\frac{3}{4}$. partes. I conclude. 29. foote there to be, and two thirde partes of a foote square, accordynge to

Fo	Yn		Fo	Yn		Yn Par		Yn Par		Yn Par		Yn Par	
1/4	48		6 1/4	1	11 1/25	12 1/4	11 3/4	18 1/4	7 7/8	24 1/4	5 15/16	30 1/4	4 3/4
1/2	24		6 1/2	1	10 1/7	12 1/2	11 1/2	18 1/2	7 4/5	24 1/2	5 7/8	30 1/2	4 5/7
3/4	16		6 3/4	1	9 1/3	12 3/4	11 2/7	18 3/4	7 2/3	24 3/4	5 4/5	30 3/4	4 2/3
1	12		7	1	8 4/7	13	11 1/16	19	7 4/7	25	5 3/4	31	4 5/8
1 1/4	9	7 1/5	7 1/4	1	7 7/8	13 1/4	10 7/8	19 1/4	7 1/2	25 1/4	5 2/3	31 1/4	4 5/8
1 1/2	8		7 1/2	1	7 1/5	13 1/2	10 2/3	19 1/2	7 3/8	25 1/2	5 5/8	31 1/2	4 4/7
1 3/4	6	10 2/7	7 3/4	1	6 4/7	13 3/4	10 1/2	19 3/4	7 2/7	25 3/4	5 5/8	31 3/4	4 1/2
2	6		8	1	6	14	10 2/7	20	7 1/5	26	5 1/2	32	4 1/2
2 1/4	5	4	8 1/4	1	5 3/7	14 1/4	10 1/3	20 1/4	7 1/8	26 1/4	5 1/2	32 1/4	4 1/2
2 1/2	4	9 3/5	8 1/2	1	4 15/16	14 1/2	9 7/8	20 1/2	7 1/32	26 1/2	5 3/7	32 1/2	4 3/7
2 3/4	4	4 3/8	8 3/4	1	4 2/7	14 3/4	9 3/4	20 3/4	6 15/16	26 3/4	5 3/8	32 3/4	4 3/8
3	4		9	1	4	15	9 5/8	21	6 6/7	27	5 1/3	33	4 1/3
3 1/4	3	8 1/2	9 1/4	1	3 4/7	15 1/4	9 3/7	21 1/4	6 4/5	27 1/4	5 2/7	33 1/4	4 1/3
3 1/2	3	5 1/8	9 1/2	1	3 1/7	15 1/2	9 2/7	21 1/2	6 5/7	27 1/2	5 2/7	33 1/2	4 2/7
3 3/4	3	2 2/5	9 3/4	1	2 3/4	15 3/4	9 1/8	21 3/4	6 5/8	27 3/4	5 1/5	33 3/4	4 1/4
4	3		10	1	2 2/5	16	9	22	6 1/2	28	5 1/8	34	4 1/4
4 1/4	2	9 7/8	10 1/4	1	2 1/21	16 1/4	8 6/7	22 1/4	6 1/2	28 1/4	5 3/32	34 1/4	4 3/16
4 1/2	2	8	10 1/2	1	1 3/4	16 1/2	8 3/4	22 1/2	6 3/8	28 1/2	5 1/16	34 1/2	4 1/6
4 3/4	2	6 1/3	10 3/4	1	1 3/8	16 3/4	8 5/8	22 3/4	6 1/3	28 3/4	5	34 3/4	4 1/8
5	2	4 4/5	11	1	1 1/11	17	8 1/2	23	6 1/4	29	5	35	4 1/8
5 1/4	2	3 3/7	11 1/4	1	4/5	17 1/4	8 1/3	23 1/4	6 1/5	29 1/4	4 7/8	35 1/4	4 3/32
5 1/2	2	2 1/5	11 1/2	1	1/2	17 1/2	8 1/5	23 1/2	6 1/8	29 1/2	4 7/8	35 1/2	4 1/16
5 3/4	2	1 1/23	11 3/4	1	2/7	17 3/4	8 3/32	23 3/4	6 1/16	29 3/4	4 5/6	35 3/4	4 1/32
6	2		12	1		18	8	24	6	30	4 4/5	36	4
Fo	Yn		Fo	Yn		Yn Par		Yn Par		Yn Par		Yn Par	

that length and breadth. I sayde (wantyng some small quantitie) because of the poynte ioyned to this fraction ⅞. whiche is put to diminysshe that fraction some little thynge, as is declared playnely in the other tables before put forthe.

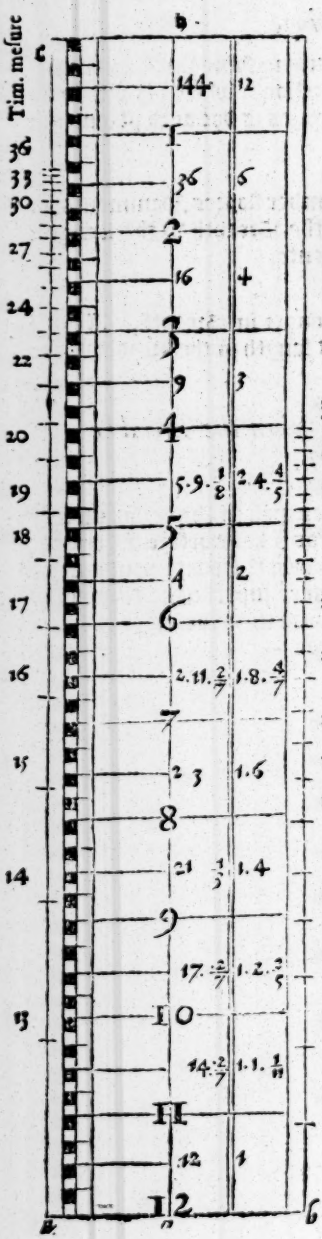
HE that desireth to measure Chamber floores, Pauiments, or such lyke: let him onely multiply the Breadth wᵗ the Length: so the producte sheweth the contente.

Ensample.

If there were a Pauement. 100. fote long, & in Breadth. 50. I must nedes conclude (by multiplicatiō of that length in the breadth) there to be conteyned. 5000. foote.

Or thus without Arithmetike when the Breadthe exceadeth the table.

DIuide the breadth in partes (as is opened in the declaration of the Table of accompt) and worke as I haue before instructed. So for Pauementes all maner wayes it serueth your turne. Of this matter to put forthe tables, were superfluous tediousnes and follye. The ingenious with these fewe, will be satisfied.



The face of the Carpenters ruler, figured with the true meaſures and other thinges neceſſarie.

The.xii.Chapter.

BEcauſe the effect of this Ruler is aboue declared by tables, an Inſtrumēt alſo well knowen and commune amonge good Artificers: I wyll not ſpende many wordes in opening it. Behold the fygures, and learne by thē howe ye ought to make, & comely to decke your Ruler, bothe with tymber and bourde meaſure.

Enſample.

ADmit ỹ ruler to be. a b c d. wel plained, twelue inches longe, a quarter of an inch thick, & two inches in bredth. Truly it wer more cōmodious, if it had two fote in lēgth This ruler here imagined but a fote in lengthe, is diuided firſt in twelue euen parts, called inches: then euery inch in half, or two equal portiōs: ech half in two quarters: euery quarter in four or two parts at the leſt: as in this enſample. When are the figures placed frō. 1. to. 12. manifeſting the inches. Thus your Ruler is ready to receaue the meaſures whyche are marked or fygured on youre Ruler thus. And fyrſt the tymber meaſure as folqweth.

Ye

Ye ſhall reſort to your table of Tymber meaſure, and ſeke how many fete belonge to. 1. inche ſquare: there ye ſhall fynde. 144. Thys number note, write, or rather graue, where thys fygure 1. repreſentyng one inche, is fygured: as ye may ſe in the myddes betwene the lyne. e. f. & the lyne of the fygures. g. h. This done, reſort to your table agayne, and beholde how many fote & partes. 2. inches ſquare requireth. So ſhall ye fynde. 36. foote, whiche is placed in the nert rounme leftward, vnder the charactere. 2. ſignifyng two inches. Thus of the reſte, fete, inches, and partes, founde in your table, vntyll you come to the twelfe inche, where ye ſhall perceyue. 12. inches onely to be ſet in his proper roume. &c. Thē ſeke further in your table, what belongeth to. 13. inches: Lo. 10. inches, & $\frac{1}{2}$. This muſt be nūbred in the lyne. c. a. from. c. whyche lyne betokeneth the thyckenes of the Ruler. Make there a little ſtryke vpon that groſnes, euen ouer ryght agaynſt the meaſure. 10 $\frac{1}{2}$. what nede many wordes? Thus do vntyl ye come to. 36. inches: and that is noted (as the table of tymbre meaſure ſheweth) ryght with. 1. inche, and $\frac{1}{2}$. from c. No otherwyſe is perfourmed of borde meaſure, as ye may beholde ſet forth by the helpe of his proper table in the ſquare roumes, beneath the lyne. e. f. and alſo in the other thyckenes ouer lyne. b. d.

The backside of the Ruler, with the Quadrant Geometricall.

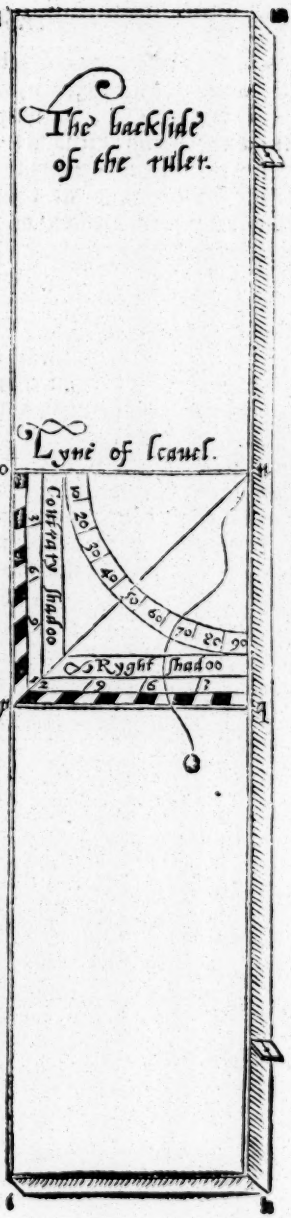
The.xiii. Chapter.

The makinge of a geometricall quadrant

THis other Figure. i.k.l.m. is the backside of your Ruler, hauyng in the middes a Geometrical quadrant. n.o.p.q. whose makyng in few wordes is thus expressed. The line or breadth of your ruler n o, the lyne o p, p q, q n, ought to be of one equal iust lengthe, cuttyng eche other squirewise. Also frō the centre. n. vnto. p. is drawen an other line, which is called the Line of height. So is o n, the line of leuell: q n, the Lyne of Heightes vpright. This knowen, I open my compasse, one fote remaynynge in the centre. n, the other extended in the lyne of leuell, almoste to. o. makynge a Circumference vnto. q. n. whyche is a porcion of a Circle named a Quadrant: and ought to be diuided into. 90. equall partes, as ye may beholde euerye of them called a degree. Ye may diuide the lynes o p, and p q, named the Scale, eche in. 12. as here, or in. 60. yea, in. 100. equall porcions is more mete, for the vse of shadows, Heightes, Lengthes. &c. Note that the side or halfe Scale. o. p. is called the Contrary shadow: p q, Right shadow. Remēbre that vpon the thicknes m k, ye oughtto haue two fine equal square sightes, well bored, represēted here by r s, made of wode, or rather metall, to be fastened there whē tyme requyreth. Let this satisfie.

Note these thre principall lines.

The diuided sides o. p. and p q. are called the Scale



The

The commune vſe of the Carpenters Ruler, touchinge the face afore put forthe.

The. xiiii. Chapter.

Suppoſe a pece of Timber to be moaten, whoſe true ſquare is. 7. inches: this ſquare appeinteth you to the figure of. 7. in the lyne. g. h. vnder whom rightwart in the place aſſigned to tymbre meaſure, is written 2. foote. 11. inches, and $\frac{2}{7}$. Aſoften as that meaſure is founde in the length of your tymbre, ſo manye ſote of tymber is in that pece. *The. 8. chapiter ſheweth how the trueſquare is founde.*

An other enſample.

Imagyne your ſquare to be. 22. inches: ſeke in the lyne. a. c. Note then how muche of your ruler is left from that, to the ende of your rule. c. and ſo muche belongeth to a foote. Therfore laye out that meaſure vpon your tymbre, and recken howe many tymes ye maye fynde it, from the one to the other of your logge: for ſo manye ſote of timber is there. Euen thus of Borde. Seke the Breadth vpon your ruler, in the roume or place of borde meaſure, and immediatly before your eyes there remayneth what is to be layed out to make a iuſt ſote of borde.

The vſe of the principall Lines in the Geometricall Quadrant on the backe ſide of the Ruler, and firſt of the Leuell lyne.

The. xv. Chapter.

It behoueth you to loke thorow your ſyghts. q. r. placed in the thickenes of lyne. k. m. a fine threde and plumet fallyng at libertye out of the centre. n. If this plummet and threde chaunce preciſely on the lyne of Leauel (whiche is. n. o.) what ſoeuer ye ſe thorow the ſyghtes, is leauell wyth your eye: if otherwiſe, the thynge that ye loke vnto is not leauel, either more or leſſe the the height or leuel of your eye: More, if the plummet fall to youward: Leſſe, if contrary.

How by the line of Leuell to foreſee whether the water of anye ſpringe or head is poſſible to be brought to a place appointed: and alſo to iudge the holeſomnes of it.

The.xvi. Chapter.

Thal go to the head or ſpringe, & ſet your Ruler to your eye, (beyng in height equal with the water) ſo that ỹ fine cord & plūmet fal precisely on the line of Leuell. Now if thorowe the ſyghtes, ye may ſe aboue the place, knowe and iudge the water poſſible to be brought: if your ſyght fall vnder, impoſſible. It cometh communely to paſſe when the place to the whych ye woulde haue water conueyed, is of anye greate diſtaunce from the heade, then hylles, valeyes, and ſuche like impedimentes lette the lyne viſuall to haue his free courſe: wherfore this remedye is prouided. At the heade of the ſpringe, ye ſhall loke thorow the ſyghtes (as before) and note a marke in the next hyll towarde the place, then go to that marke: in lyke maner obſerue there an other in ſome hyll: ſo forthe vntyll by any of them ye may perceyue the place deſiered. If then your ſight rūning through the pinnes of your ruler, (the threde euer failynge on the lyne. n. o.) excede that place, the conueyinge of your water is poſſible: otherwiſe not. Nowe by the waye briefly ye ſhall be enſtructed howe ye maye knowe the holeſomneſſe of water.

Howe good water is knowen.

Take a cleane pot and put water in it: ſo ſet it on the fyre: after a little boylyng, poure it out: if then no fylthe remaine in the bottome of the potte, it maye be iudged the holeſomer. Or thus. Let fall droppes vpon metal, or rather on glaſſe (any of them beyng poliſhed) and ſuffer that to drye by it ſelfe: if after there remayne no ſpot or ſygne, it is a good taken. Moreouer, if your water be ſwete, pure, cleare, lyght, or of little weight, it followeth that water to be holeſome for the vſe of man.

Of

Of the line of Height.

When ſoeuer the threde and plummet dō chaunce iuſtly on the height whiche is n p: the altitude or height that ye ſee is euen with the diſtaunce from the middle of your fote to the nether parte directly vnder the toppe equal with your ſtandynge, addynge the height of your eye downwarde. Knowe that ye muſt euer ſtande vpryght wyth bodye and necke, your fete iuſte together, the one eye cloſed. &c.

The line of vpright Altitudes.

Iudge alſo any thyng plumbe vpright when the thickenes of your Ruler. i. l. is cloſely theron, the plummet then at libertye, fallynge on. q. n, named the lyne of Heightes vpright. Nowe folgweth the vſe of the Scale.

To ſearche out heightes by the Scale, with the ayde of two places,

The. xviii. Chapter.

Set the threade and plummet fal in the one, on the 12. poyntes: in thother ſtacion, on the. 6. of the right ſhadowe: double the diſtance betwene the two places, the ſummitie appeareth from that part of the thinge meaſured, whyche is equall in height wyth your eye. Or the one in the. 12, the other in. 8. of ryght ſhadow: then triple the diſtaunce. The one in the. 12. the other in. 6. of ryght, quadruplate the ſpace. The one in the. 12. the other in 6. of the contrary ſhadow, then the ſpace betwe e both the ſtacions is equall wyth that ye meaſure, euer vnderſtandyng from your eye vpwarde. Euen that ſame cometh to paſſe, if in the one the threde be found vpō the. 6. of the cōtrary, in thother on the. 4. of the ſame. or the. 4. and. 3. of the contrarye: In all theſe the Spaces are equall wyth the altitudes. So then in meaſuryng the diſtaunce betwene the two places, ye haue the heyght, from your eye vpward, puttyng to it the lengthe from your ſyght downewarde, the whole Altitude appeareth: the baſe beynge equall wyth your ſtandynge.

I Woulde not haue you ignorant here how to knowe lengthes whiche be in height not eaſye to come vnto. Firſte (as before) get the height of the toppe, the the altitude of the baſe or longeſt part of your lengthe. Subduct the leſſe height out of the more: of force your deſiered length remayneth. Or thus: let the plummet and threde fall in the.12. marke your place: go in towarde the thyng (the threde as it was) vntil ye ſee the baſe of that length: the diſtaūce betwene the two ſtandynges, is vndoubtedly the length.

How lēgthes in heighte are knowen.

How with the Scale, direct or vpright heightes, by their ſhadowes are declared.

The.xix. Chapter.

TArne your leftſyde vnto the Sunne, ſufferynge his beames to pearce bothe your ſyghtes. q. r, placed as afore is ſayed in the thyckines or lyne. k. l. The threde or plummet then hangyng at libertye out of the centre. n. ſheweth aſwell the degrees of height, to be compted from. o. as the partes of the Scale cut. If your threde be founde in the. 12. parte, or lyne of leauell, ſhadowes of all thynges beynge perpendiculer eleuated, are equall wyth their bodies. If the plummet with the threde be perceiued cuttynge the partes nert to the ſyghtes which I name poyntes of the ryght ſhadowe, then euery thynge direct is more then his ſhadowe, by that proporcion whiche. 12. exceadeth the partes, where the threde was founde. If it fall in. 1. that is the fyrſte parte of the ryght ſhadowe, take the ſhadowe twelue times to make the height. In two: that is the ſecond parte, ſixe times. In the thirde, foure times. In the fourth, three times. In the fift, twyſe: and $\frac{5}{7}$ of the ſhadow. In the ſixt, twyſe. In the ſeuenth once, and $\frac{5}{7}$. In the eyght once: and $\frac{1}{2}$. In the nynthe once, and $\frac{1}{3}$. In the tenthe once, and $\frac{1}{5}$. In the eleuenth ye ſhall take the ſhadowe once, and $\frac{1}{11}$ parte of it.

Right ſhadowe.

If the arte of numbryng were had, I woulde wyll you to multiplye the Length of the ſhadow by. 12. and the product diuide by the partes, in the whych ye founde the threde.

But and if it be in the partes of the contrary ſhadowe, augment the

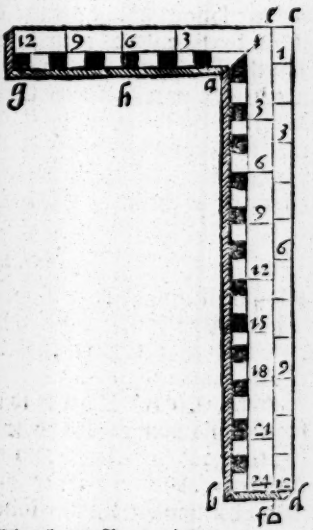
the lengthe of the ſhadowe wyth the partes declared by the plummet: and the encreaſe diuide by. 12. ſo commeth the altitude alſo. *Contrarye ſhadowe.*

Thus the compoſition and whole appliance of the Carpenters ruler is ſhewed: therfore ſomewhat ſhal be now ſayde of the ſquire.

I am not ignorant that the cõmune vſe of him is better knowen than I can wyth many wordes expreſſe, wherfore I leaue to write in that behalfe. Notwithſtandynge I wyll declare how Heightes, & Lengthes are taken. &c. matters rare, and knowen of few Artificers. Alſo by tables to get a true knowledge of the daye houre, and that diuers wayes, wyth the helpe of the ſquyre: as is opened in my generall Prognoſtication augmented in the yere of our Lord. 1556.

What length the ſides of thy Squire ought to be, and the diuiſion of him.

The. xx. Chapter.



I Nede not to put forthe the exacte making of this Inſtrument ſo wel knowen. Loe therfore the fygure. One ſide ſuppoſed two fote from the inwarde angle: and the other a inche fote from the ſame. The longer. a. b. inwardly dimded from the angle. a. vnto. b. into. 24. equall principall partes, and euery of them into a leſſe (if ye lyſt) eche conteynyng. 10. minutes. Alſo the ſide. c. d. in the outward contrary plaine from the toppe. c. vnto. d is diuided into. 12. euen portions: and again (if ye requyre exactnes) euery of thẽ into. 6. eche of value. 10. minutes. Behold a line & plũmet fallyng from e. to. f. a parallel to c d, and a. b. Thus this ſquire is wel framed for the vſe of diuers tables put forthe in my generall prognoſticatiõ, & alſo for the fyndyng of Altitudes and Longitudes, which here I purpoſe now briefly to open.

The vse of the Howe by this Squire heightes are knowen.

ALtitudes or heyghtes are founde, the lyne or plūmet centred in the.6.poynte, cuttynge.h.the middle of.a.g. The moueable sightes placed in.a.g, or a paralel from that lyne, not vnlyke as is opened of the lyne of height, in the backe of my ruler.

How Lengthes in plaine grounde are searched by the Carpenters or Masons Squire.

The.xxi.Chapter.

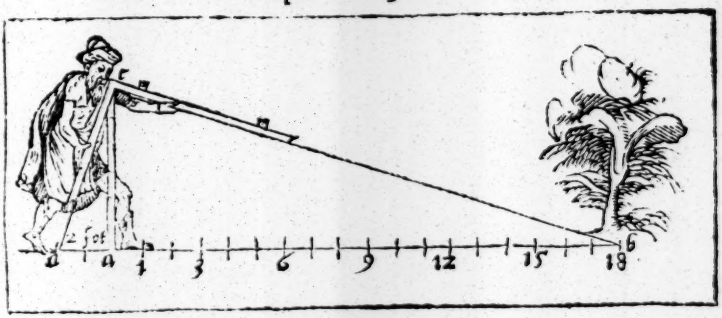
TAke a staffe diuided into certayne portions as ye lyst, in.100. or a.1000.parts. At the beginnyng of your Length vpon the very toppe directlye standynge: set the inwarde angle of the squyre: lift vp or put downe this instrument vntyll ye see the fardest parte of your longitude. I meane vntyll your syght runnynge from that angle, to the ende of your squyre come vnto the fardest part of that length. The squire so remaynynge, and the staffe not removed from hys height, marke where the other end of the squyre nert vnto you noteth vpon the grounde. See what proportion the staffe then beareth to the part of the grounde, whych the nereſt ende of the squire poynted vnto from the staffe, the same shal the Length haue to the quantitie of the sayed staffe.

Ensample.

The cause is taken out of Euclide. 32. pro. 1. boke: and the. 4. pro. 6. boke.

THe staffe.a.c.in this sygure is imagined.6.fote, & the space.a.b. 2.fote, Considerynge nowe that.6.the lengthe of the staffe conteyneth.2. thrise, therfore the longitude desiered.a.b. of force muste conteyne thre tymes the staffe (whiche staffe is.6.fote,) that maketh.18.fote. As this is proued true by a small grounde in the sygure folowynge: so the arte fayleth not in a greater space, whiche the good speculator and diligente practiser by anye wayes canne not denye. Yet experience willeth me this to cōfesse, that the squire is not conuenient for any long distaunce, but the Instrument Geometricall (whose makynge and vse ye may perceyue in the treatyse folowynge) vnlesse ye ascende some Tree or turret for your ayde, whiche length knowen, shal stande in the stede of your staffe.

It



A Note.

IT behoueth you to haue a fyne coarde, made fast in the vpper parte of your staffe. c. whyche shall be tyed euen wyth the inward edge of the squyre, and so drawen to the gronnde, where the neare ende of the square from the staffe poynted, as ye see. d. c. the other ende then truelye directynge to the fardest distaunce.

Knowe that the grounde must be very playne and leauell, otherwyse errours ensueth.

Thus the vse of the Squyre is here somewhat declared, but more in my generall Prognostication, yea, moost plentifullye hereafter (God sparynge lyfe) in a booke titled the rare vse of the Squire in practises Mathematicall: in the which boke profitable pleasaunt experiences shall be playnelye opened (onelye of me practised) as well of Perspectyue, as of the Mathematicals in generall.

I Had thought here folowyng to haue placed the ready handelynge of the compasse, yea and to haue shewed the fygurynge and true makynge of all maner letters, both Texte and Romayn, with the best proporcion, the quantity as ye would demaũde, besides that, so to place them in height and nearer to the sight, that they beyng of diuers magnitudes myght appeare to the eye, of one bygnes. This when I did attẽpt to bryngе to their capacitie, semed somewhat difficulte wythout pennynge many wordes. Wherfore I omitted it, belongyng rather to the Paynter, then to the Carpẽter for whose sake onely the rest afore semeth to be compiled. Here after (as I se men desireful) my endeuour shall be to adde that, and other thinges necessarie.

¶ A little treatiſe declaringe the makinge and vſe of an Inſtrument Geometricall (ſo farre as it ſardereth the Landemeter or Carpenter) named the profitable Staffe.

To the Reader.

Sayed in the beginnyng that no little boke woulde conteyne the makynge, and manifolde fruites of this princely Inſtrument, if it were ſet forthe as it ought to be.

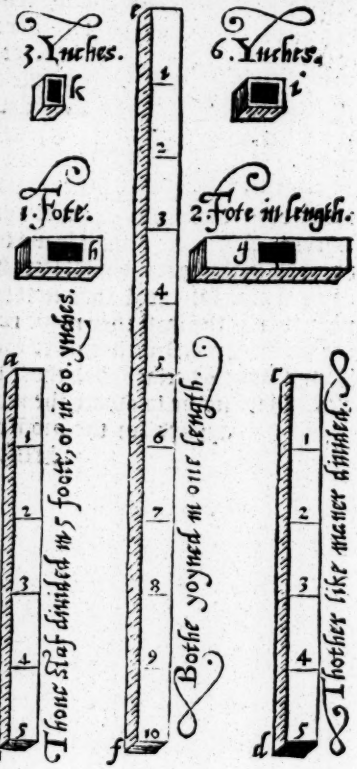
Certes the trueth euen here maketh me confeſſe the ſame: yea, that there is no inſtrument ſo generall & profitably pleaſant. Notwithſtandyng know (gentle reader) that the occaſion of his chiefe vſe and profite is not here miniſtred: nether (to ſay the truth) doth it apperteyne to, or agrée wyth the capacitie of ſuch Artificers. Therfore I ſhall leaue to intreate of hys ample large vſe, and beſt makynge, and wyll ſette hym forthe in fewe wordes: yea, ſufficientlye for the Landemeters capacitye, or Carpenters purpoſe, that at the leaſt they maye receaue ſome kynde of fruite wyth the Geometrer. And in time to come (by other meanes as I ſe cauſe) I wyll largely declare, and there decke hym wyth hys proper beauties. Here nowe foloweth the makynge, and ſo briefly howe he is applied for the profite of the afore named Artificers.

He that deſireth manifolde fruites of this inſtrumẽt, legat gẽometricii de radio aſtronomico, & geometrico, libruꝫ.

The making of this profitable Rodde or Staffe.

The fiſte Chapter.

WE ſhall prepare two ſmall, ſtrayght, ſlyſſe, rounde, or rather ſquare Rodes, of metal or of wodde wel playned, of lyke bygnes and lengthe. Althoughe it make no matter of what lengthe, yet to auoide the errours, whyche little inſtrumentes & ſhort ſtaues bryngе, and alſo to beare wyth the rude vnwonte handelynge of ſuche Artificers: let your Rodes be eche fiue, or at the leaſt thre fote, and euerye fote diuided in. 12. euen partes or inches, as ye ſe a b, and c d. Theſe rodes muſte be forged wyth a vyze in the ende of them to ioyne readely. 10. or. 6. foote in lengthe, (when time requireth) as the Figure e f. ſheweth. Alſo ye muſte get (bi the helpe of ſome Crafteſman. 4. other like rodes, the longer. g. 2 fote: the nert. h. 1 fote: the other. i. 6 inches: then. k. 3 inches: the laſt and ſhortеſt. l. 1. inche & ½. Eche of theſe muſt haue in their myddes an hole, that the longe ſtaffe of. 10. fote maye be put throw them, & they moued on him at pleaſure vp & downe, alwayes cuttynge the longer Staffe. e. f. ſquyzewiſe, and made to tary on any diuiſion as occaſion ſhall be geuen: whiche all are eaſye to be perceyued by the figures folowynge, although my rude declaration hath not expreſſed my meanynge.



Here

Here note in the ſtede of your ſhorte Staues, ye may haue one croſſe ſtaffe two fote long, with currant ſightes, ſo artificially made, that alwayes the ſhorte ſtaffe ſhall runne ſquyre vpon the longer, and the ſyghtes diſtaunt, as ye lyſt to place them.

Thinges nedefull to be knowen, before the vſe of this Inſtrument is opened.

The.ii Chapter.

Beſore I entreate of his vſe, it behoueth to knowe thinges neceſſarie, and firſte whiche of the.5. little ſtaues, g, h, i, k, l, mencioned in the makynge, is to be put vpon your longe ſtaffe. e f, accordyng to the diſtance of the marke. Note if your marke be nere hand, be it Length, Breadth, or Height, the longer g. dothe ſeme meateſt to haue the roume: if more of lengthe, the other. h: and ſo the farder diſtaunce, the ſhorter the ſtaffe requyreth to be, whiche ſhall occuppe that place. Oft practyſe ſheweth this better then many woordes. Alſo note, if chaunce be to go in towarde your marcke (as after ye ſhall ſée howe) you muſte moue the ſhorte ſtaffe inwarde more neare to the ende of the longer. e. If ye be compelled to go from it: then put it from e, towarde the ende. f. Alſo remembre when ye are appoynted to meaſure any Breadth or Lengthe (as ſhall be declared) it behoueth you to ſtande rightwith, and againſt that breadth: yea, and the longer the breadth, or larger the wydenes or length is, the better the thinge will come to paſſe.

If you haue but one croſs Staffe, the nerer the diſtaunce is, the farder the ſightes maie he put the one from the other.

And for heyghtes it is neceſſarye (if ye regarde all preciſenes) to haue the height ſtande directly vp.

Note this that foloweth to be generall in all workinges.

Thinges neceſſarie to be knowen.

Ye muſt ſtande right vp with your bodye and necke, your fete muſt together, your handes not muche mouing, the one eye cloſed, and euer marke your ſtandynge ryght with the myddes of your fete. Be not ignorant here, that I cal the extreames of the little

What theſe words meane Longitude, Latitude, Altitude.

tle ſtaues, the verye endes where the ſyght euer runneth. And no difference betwene the altitude and height, betwene the longitude and length: the latitude and breadth. The ſhorte ſtaues I name by the letter ſygured ouer them. Your eye muſt euer be placed in the ende of the longer ſtaffe. e, & wyth the other eye, ye ought to winke These trifles and ſuche lyke omitted let the truthe to come to paſſe, & make men to ſuſpect the Ground, whych is moſt certeyne.

Howe Heightes ſtandinge directl, e vp, are meaſured by this Inſtrument.

The. iii. Chapter.

Put the ſtaffe. g. vpon the longer. e. f, and moue him his iuſt length from the beginnyng of the longer. e: turne the endes of. g. toward and accordyng to that height: placyng your eye (as is ſayde) euer at the beginnyng of the longer. e. wyth thother eye wynke. Then go backe vntyll ye may playnely perceyue the very vpper part of that altitude, and alſo the lower ende, by the extreames of your ſhorter ſtaffe. g. Nowe the ſpace from the myddle of your fote to the Baſe of the heyght, is equall wyth that altitude.

Or thus: when ye ſhall ſée any altitude, whoſe meaſure ye require, imagyne by coniecture howe oftentymes that heyght is founde in the ſpace from it vnto your ſtandynge. Then moue your ſhorter ſtaffe, (choſen as aboue moſte conuenient) euen as often hys owne length, from the beginnynge of the longer. e, where your eye is euer placed. This done, turne thendes of your little ſtaffe, (your eye beynge in. e.) accordynge to the heyght: loke whether ye may ſée by the extreames of your ſhorter the verye toppe, and alſo the loweſt parte of that height. If not, moue the ſhorter a lengthe further towarde. f, or nearer to. e, as ye ſée cauſe, and as your coniecture fayled. Or let your little ſtaffe remayne, as by coniecture he was put, and go towarde or from that heyght, vntyll the altitude agree iuſtlye with the extreames of your ſhorter Staffe. Then marke that place euen with the middes of your fote.

Nowe ye maye conclude, that the height is as often contayned

in

in the diſtaunce, whiche is betwene your marke and it, as the Lengthe of the lyttle Staffe is founde remoued from the ende of the longer. c.

Enſample.

IF the ſhorte ſtaffe be ten tymes hys owne length from. e, aſſyme the height to be conteyned in that diſtaunce. 10. tymes onely.

The Altitude is thus gotten. Moue your ſhorte Staffe from his lattre beynge, a lengthe either towarde or from. e. as ye lyſte to go in or backe. Then go fro or neare vnto it (as afore) vntyl the very ſummitie, and alſo the loweſt part of the height agree wyth the extreames of your ſhorter ſtaffe. The ſpace then betwene your firſte marked place, and this later, declareth the iuſte height. Oftetimes thorow impedimētes, ye ſhall not haue roume to go ſo farre backe or forwarde, as the heyght cometh vnto. This remedye is prouided. Moue the little ſtaffe halfe his length, and ſo seke two ſtacions (as afore) vntyll the extreames of the ſhorter ſtaffe be founde iuſtly to anſwer either ende of the heyght. Then the ſpace betwene the two ſtandinges muſt be doubled to haue the iuſt height. Or if ye lyſt, ye maye moue the ſhorter accordynge to the fourthe parte of his lengthe, or to any portion, as to the fift, ſyxte, twentye. &c. then ſhall ye haue that parte of the height, betwene the two ſtacions.

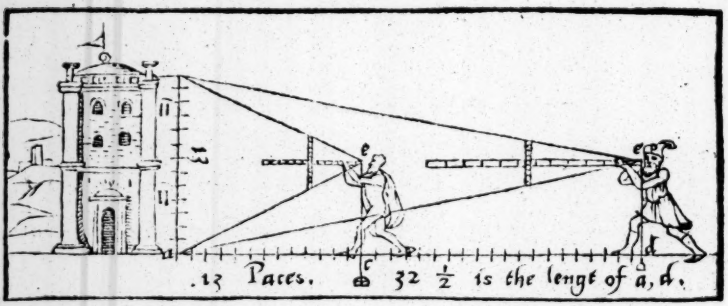
How the iuſt height is knowen.

A remedie prouided for wāt of grōd

Yet know this (which experience by diligent practice wyll ſhew) the bigger partes ye take, the leſſe errour ye committe: A little errour often multiplied, encreaſeth to a great.

Nowe that all the afore ſpoken may the better be perceiued, beholde the enſample enſuynge, as ye ſe by fygure declared, in the which the height is imagined. a. b. the firſte ſtacion. c. the ſhort ſtaffe g. is moued from. e. iuſt his length. I am forced to cōclude, that the Baſe of the height. a. b. is from my ſtandynge. c. euen hys preciſe lengthe. So then if ye meaſure that diſtaunce of. a. c. beynge. 13. paces, ye haue the true height of. a. b. as many. In the other ſtandynge place. d. the ſhorter ſtaffe is founde from. e. twyſe his lengthe and a halfe: wherfore I muſt aſſyme the height. a. b. to be conteyned or founde in the diſtaunce. a. d. twyſe and a halfe, whyche length. a. d. is apparant. 32. paſſis. All this that is ſpoken of the Height, may wel be vnderſtand of Latitudes or Wydenelles, & Lengthes folowyng.

The grounde of this maie be gathered of Euclide in his perſpectiue 21. theo.



How the Breadth or Widenes of thinges are founde, and bi them Lengthe or anie Diſtaunce, at pleaſure.

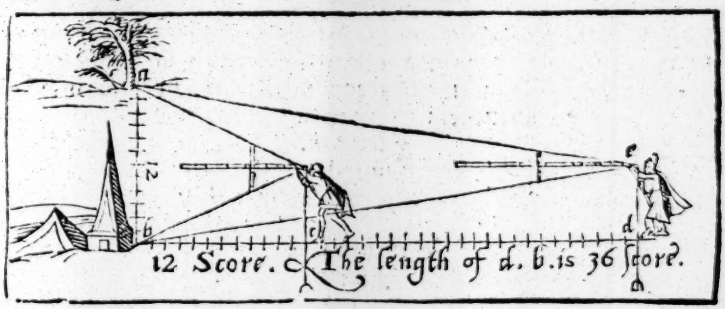
The.iiii. Chapter.

WHatſoeuer I haue enſtructed afore of Heightes, the ſame vnderſtand here of Wydenes, Lengthes. &c. For none otherwiſe are Latitudes or Wideneſſes ſearched by this Inſtrument, then before is declared of Heyghtes, onely this excepted, that the ſhort ſtaffe muſt lye contrary, thendes accordyng to the breadth, ſeyng by the extremes of the ſhorte ſtaffe, the very vttermoſt partes or endes of the Latitude, notynge your ſtacions ryght with the middes of the fote. And ſo performe all, as tofore. And as I ſayd there of the partes of the Height found betwene your ſtandinges, euen the ſame thing is well vſed here, for all maner partes of the Breadthe.

Enſample.

THe Breadth in this fygure folowyng is ſuppoſed. a. b, alſo the firſte ſtation. c, the next. d. My deſire is to know the Wydenes a. b, and the Lengthe or diſtaunce. d. b. Marke howe the endes of the leſſer ſtaues are turned to the extreames of the Wideneſſe. Then beholde howe the ſhorte ſtaffe in. c, is but once his lengthe remoued from. e. Wherfore (by the inſtructions of Heightes afore) ye may boldly ſaie, that the Widenes. a. b, is but once conteined betwene

thence.b.and.c.and that measure is founde.12.score,as muche is the other.a.b. In the seconde standynge.d, the little staffe is remoued thre tymes his lengthe from. e. For that cause I conclude (and truely) from.b.to that station thre tymes the Breadthe, whiche breadthe is.12.score. So by the wydenesse I haue founde the Lengthe of.b.d.36.score,my desire. Thus are Latitudes founde,and by them Lengthes.&c Beholde the figure.



When soeuer any distaunce is put, whose certayne length ye requyre:measure(by the arte expressed) either the Height of any thing there found,or the Breadth,and see how often times that Widenes or Lengthe is conteyned vnto your standynge:whiche knowen, the Length can not be hydde,as is declared.

NOwe in few wordes to conclude,ye may by this Instrument measure the distaunce of Houses,Steples,Trees, the length of Walles,the breadth of Dytches,Imagies in heyght,& such lyke. The good witty Carpenter standing in a place where he may playnely see a whole house,or any maner frame, wyth greate pleasure may by this get spradely the true proporcio of that house,whiche he oughte to note in a table,and when tyme cometh, not wythout his greate prayse,may make,reare,and set vp the lyke. This I take to be sufficient for these Craftesmen. *A more large verse of this Instrument.*

IHaue before forgotten to admonishe you, when so euer ye liste to measure any lande exactlye,by the Instrument Geometricall,named the profitable Staffe, to set vpryght a Rodde, the length of a Pearche. Or if the distaunce be longe, to passe out,or rather iustlye *How the length of Lande is exactlie founde.*

lye mete fine or moe Pearches at the ende or head of your lengthe, the extreames noted wyth two visible markes: Then goo from thence & seke the Length by that certayne Wideines, as is declared: so shall ye not fayle to bringe verye true lande. Note that a lyttle errour founde in the Breadth, oft multiplied, encreaseth to a great, yea, to an intollerable fault in the Length, therfore the Breadth or Wideines ought truely to be searched. This I take sufficiẽt for these Craftesmen.

I woulde desyre where my grosse writtinges seeme to be obscure, that I were presente the instructoure: for truely a lively voyce of a meane speculatour somewhat practised furdereth tenfold more in my iudgement, than the finest writer.

Farewell.

Accept my good wyll,
and loke shortlye (if God spare lyfe)
for a profitable increase of
these matters.

Finis.